BG800-1-A

NUEXCO

SEPTEMBER 1986 NUMBER 217

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

Three Park Central 1515 Arapahoe Street, Suite 1045 Denver, Colorado 80202

HEADQUARTERS

Chairman of the Board of Partners
Oren L. Benton

Vice Chairman of the Board of Partners and Chief Executive Officer
Samuel R. Freeman

Directors of Operations
Business and Financial Affairs — James E. Lewis
Administration — J. Fred Lawrence
Legal and Regulatory Affairs — Frederick J. Boyne

NUEXCO FUEL BROKERAGE SERVICES

Manager of Fuel Brokerage
Earl E. Hoellen, Jr.

BROKERAGE SERVICE LOCATIONS

UNITED STATES

DENVER
Three Park Central
1515 Arapahoe Street
Suite 900
Denver, Colorado 80202
Telephone: (303) 893-4015
Telecopy: (303) 825-4821
Telex: 450202 (NUEXCO DVR)

Managing Broker
Earl E. Hoellen, Jr.

MENLO PARK
Bldg. 3, Suite 290
3000 Sand Hill Road
Menlo Park, California 94025
Telephone: (415) 854-1510
Telecopy: (415) 854-2115
Telex: 470674 (NUEXCO UI)

Managing Broker
George White, Jr.

EUROPE

FERNEY-VOLTAIRE
13 chemin du Levant
01210 Ferney-Voltaire
France
Telephone: (33-50) 428035
Telecopy: (33-50) 428526
Telex: 385288 (NUEXCO F)

Managing Broker
James E. Vaughan

ZURICH
135 Zurichstrasse
CH-8700 Kusnacht
Switzerland
Telephone: (41-01) 910-8977
Telecopy: (41-01) 910-6672
Telex: 58877 (COMAG)

Managing Broker
Donald P. Ebright

REGIONAL MANAGING BROKERS

AFRICA
James E. Vaughan

AUSTRALIA
George White, Jr.

FAR EAST
Earl E. Hoellen, Jr.

NORTH AND SOUTH AMERICA
Earl E. Hoellen, Jr.

(See inside back cover for list of Representatives and Consultants.)

NUEXCO

MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

September 1986 No. 217

R. WESLEY MILLER, *EDITOR* CLARK M. BEYER, *ASSOCIATE EDITOR*

PRICING
Natural Uranium and Conversion 1
Enriched Uranium and SWUs 1

CURRENT MARKET DATA
Nuexco Market Data Table 2
Prices Expressed in Selected Currencies 3
Recent Transactions 5
Supply and Demand Tables 6

ANALYSIS AND COMMENTARY
Nuclear Electric Generating Capacity Forecast 10

COMMENTARY
The Spot Market and the Spot Price: Applicability and Limitations 19

RECENT DEVELOPMENTS
Australia 22
United States 22

UPDATE
Japan's Fuel Cycle Facilities 25

HISTORICAL MARKET DATA
Graph of Exchange Value and Transaction Value 29
Historical Exchange Value, Transaction Value and Conversion Value 30

GOVERNMENT STATISTICS
Australia 31
Canada 32
South Africa 33
United States 34

NOTICE

This Report is prepared especially for Subscribers and is furnished to them for their use only. Except for internal use by Subscribers, no part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of Nuexco. Neither this Report, nor copies of any portion thereof, may be lent, sold or given to non-Subscribers.

The information in this Report was gathered from sources Nuexco believes to be accurate. However, Nuexco makes no warranty, express or implied, and assumes no legal liability or responsibility for the accuracy, completeness or usefulness of any information contained herein.

© NUEXCO 1986

To Our Readers

Nuexco is pleased to announce that **Mr. Don A. Nichols,** located in our Denver headquarters, will lead Nuexco's activities in the brokerage of mineral properties, as well as the arranging of joint ventures and the buying, selling and financing of companies in the nuclear industry. He will work closely with Sam Freeman, John Amman, Jim Lewis, and others to assist customers in these types of transactions. Prior to joining Nuexco earlier this year, Mr. Nichols served as Vice President of Acquisitions and New Ventures for Getty Mining Company, a subsidiary of Getty Oil Company, where he negotiated agreements on uranium and other mineral properties throughout the world. Prior to his association with Getty, Mr. Nichols was an independent landman in natural resources, and during the Korean Conflict he served as a jet fighter pilot in the U.S. Marine Corps. Mr. Nichols brings over 25 years of valuable experience in land management, property acquisitions, and business negotiations to Nuexco and Concord-Nuexco International Corporation.

* * *

Included with this Report is a copy of the Raw Materials article entitled "The Rabbit Lake Project." The article was collated incorrectly in last month's Report (#216, August 1986, pages 25-31). We apologize for any inconvenience this error may have caused.

© NUEXCO 1986

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

(All data as of August 31, 1986)

The **Exchange Value** is **$17.00** per pound U_3O_8, unchanged since last month. **Active supply** of natural uranium (concentrates and UF_6) for spot or near-term delivery totals **4,230,000** pounds U_3O_8 equivalent, up 355 thousand pounds since last month. The corresponding figure for **active demand** is **1,450,000** pounds, down 1.2 million pounds. The spot and near-term **supply-demand ratio** rose to **2.9:1.**

The *Current Market Data* section of this Report lists five natural uranium sales, involving approximately 1.5 million pounds equivalent U_3O_8. All of the transactions involved spot or near-term delivery, and four met the criteria for inclusion in the current Transaction Value calculation. Two of the transactions involved natural UF_6.

The **Transaction Value** is **$17.45** per pound U_3O_8, down $0.05 since last month. The calculation extends over a 3-month period and includes 14 transactions involving 2.6 million pounds equivalent U_3O_8.

The **UF_6 Value** is **$48.00** per kilogram U in UF_6, down $0.25 since last month.

The **Conversion Value** is **$1.90** per pound U in UF_6, up $0.10 since last month. Active supply of secondary market conversion services for delivery within three years totals 1.3 million pounds U as UF_6. Active demand totals 1.0 million pounds U as UF_6. No secondary market conversion transactions are reported.

The **Loan Rate** is **4 percent** per annum, unchanged.

* * *

The Exchange Value was unchanged this month as little buying activity was observed outside the USA during the customary vacation period in Europe. A significant amount of demand was removed from the market, either through transactions or once-active buyers leaving the market for a period of time. Several US utilities made purchases or expressed interest in US-origin uranium during August, but the premium for US material appeared to weaken as utilities increasingly have delayed buying decisions until there is some resolution of the US uranium producers' lawsuit versus DOE. Initial Circuit Court appeal hearings in that case are scheduled to begin September 11 in Albuquerque, New Mexico.

Different market segments are becoming more clearly defined as a function of the origin of the material. Canadian producers appear to dominate the seller side of the market, as US producers have effectively taken themselves out of the market by asking prices around the $19 to $20 per pound level. One US producer, however, made two sales for immediate delivery at competitive prices during August. US buyers generally have been able to obtain US-origin material through swaps, so there has been no buyer movement toward paying the higher asking prices of most US producers. Because of the decreasing number of buyers interested in material of Southern African origin, such uranium can be obtained at a substantial discount.

The UF_6 Value fell slightly as that market weakened. Some sellers of UF_6 are incorporating later deliveries, extended payment terms, and other methods to avoid cutting prices in the face of reduced demand. One transaction took place at a low price, and at least one other UF_6 seller appears willing to sell at prices around $48.00.

The Conversion Value rose to $1.90 as another potential buyer emerged. There remains a wide gap between sellers' offers and the prices the few potential buyers are willing to pay. Because of this situation, the secondary conversion market is still largely inactive.

* * *

ENRICHED URANIUM AND SWUS

The **SWU Value** as of August 31, 1986, is $78 per SWU, unchanged since last month. This refers to SWU at a tails assay of 0.30 weight-percent U_{235} and for delivery within one year. No secondary market SWU transactions are reported this month.

The secondary market for SWU remains dormant due to the general absence of buyers with near-term needs. If there is some resolution in the producers' favor of DOE's appeal proceedings in the next few weeks, some US utilities may again explore possibilities for purchasing enrichment services on the secondary market. Until that time, little market activity is anticipated.

©NUEXCO 1986

NUEXCO

CURRENT MARKET DATA

August 31, 1986	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$17.00**/lb. U_3O_8	4,230	1,450
UF_6 VALUE	**$48.00**/kgU		
CONVERSION VALUE	**$1.90**/lb. U as UF_6	1,300	1,000
SWU VALUE 0.3 tails assay; delivery within one year	**$78**/SWU		
LOAN RATE	**4%**/annum	0	0

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**17.45**	2.6	14	3

[1]Supply and demand tables in *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Value** represents Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not included in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the SWU Value, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminate variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

© NUEXCO 1986

CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Aug 31, 1986)	Last Month (Jul 31, 1986)	12 Months Ago (Aug 31, 1985)	This Month (Aug 31, 1986)	Last Month (Jul 31, 1986)	12 Months Ago (Aug 31, 1985)
Australia (dollar)	27.91	27.96	22.74	72.55	72.69	59.13
Belgium (comm. franc)	720.03	742.68	899.89	1,872	1,931	2,339
Canada (dollar)	23.66	23.51	21.78	61.51	61.13	56.63
Finland (markka)	83.50	85.34	94.45	217.07	221.87	245.55
France (franc)	114.25	116.44	135.82	297.02	302.71	353.11
FRG (mark)	34.86	35.89	44.46	90.64	93.30	115.58
Italy (lira)	24,021	24,648	29,840	62,450	64,080	77,576
Japan (yen)	2,651	2,640	3,793	6,893	6,864	9,862
Netherlands (guilder)	39.26	40.46	50.09	102.07	105.18	130.22
South Africa (rand)	43.93	42.43	45.71	114.20	110.30	118.85
Spain (peseta)	2,274	2,310	2,613	5,911	6,007	6,795
Sweden (krona)	117.57	118.96	132.45	305.64	309.28	344.34
Switzerland (franc)	28.13	28.80	36.45	73.12	74.87	94.77
UK (pound)	11.49	11.39	11.43	29.87	29.62	29.72
US (dollar)	17.00	17.00	16.00	44.20	44.20	41.60

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Aug 31, 1986)	Last Month (Jul 30, 1986)	12 Months Ago (Aug 31, 1985)	This Month (Aug 31, 1986)	Last Month (Jul 31, 1986)	12 Months Ago (Aug 31, 1985)
Australia (dollar)	28.64	28.78	21.46	74.47	74.83	55.80
Belgium (comm. franc)	739.09	764.53	849.27	1,921	1,988	2,208
Canada (dollar)	24.29	24.20	20.56	63.14	62.93	53.45
Finland (markka)	85.71	87.85	89.14	222.82	228.39	231.74
France (franc)	117.27	119.86	128.18	304.88	311.62	333.25
FRG (mark)	35.79	36.94	41.96	93.04	96.04	109.08
Italy (lira)	24,657	25,373	28,161	64,104	65,965	73,213
Japan (yen)	2,721	2,718	3,580	7,075	7,066	9,307
Netherlands (guilder)	40.30	41.65	47.27	104.77	108.27	122.89
South Africa (rand)	45.09	43.67	43.14	117.22	113.54	112.16
Spain (peseta)	2,334	2,378	2,466	6,067	6,183	6,412
Sweden (krona)	120.68	122.46	125.00	313.74	318.38	324.97
Switzerland (franc)	28.87	29.65	34.40	75.06	77.07	89.44
UK (pound)	11.79	11.73	10.79	30.66	30.49	28.05
US (dollar)	17.45	17.50	15.10	45.37	45.50	39.26

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on Aug. 29, 1986.

© NUEXCO 1986

NUEXCO

CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Aug 31, 1986)	Last Month (Jul 31, 1986)	12 Months Ago (Aug 31, 1985)	This Month (Aug 31, 1986)	Last Month (Jul 31, 1986)	12 Months Ago (Aug 31, 1985)
Australia (dollar)	3.12	2.96	2.27	6.88	6.53	5.01
Belgium (comm. franc)	80.47	78.64	89.99	177.42	173.36	198.39
Canada (dollar)	2.64	2.49	2.18	5.83	5.49	4.80
Finland (markka)	9.33	9.04	9.45	20.57	19.92	20.82
France (franc)	12.77	12.33	13.58	28.15	27.18	29.94
FRG (mark)	3.90	3.80	4.45	8.59	8.38	9.80
Italy (lira)	2,685	2,610	2,984	5,919	5,754	6,578
Japan (yen)	296.32	279.55	379.33	653.27	616.29	836.27
Netherlands (guilder)	4.39	4.28	5.01	9.67	9.44	11.04
South Africa (rand)	4.91	4.49	4.57	10.82	9.90	10.08
Spain (peseta)	254.11	244.63	261.35	560.22	539.32	576.18
Sweden (krona)	13.14	12.60	13.25	28.97	27.77	29.20
Switzerland (franc)	3.14	3.05	3.65	6.93	6.72	8.04
UK (pound)	1.28	1.21	1.14	2.83	2.66	2.52
US (dollar)	1.90	1.80	1.60	4.19	3.97	3.53

SWU VALUE AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	SWU Value delivery within one year (Aug 31, 1986)	UF_6 Value per kg.U in UF_6 This Month (Aug 31, 1986)	UF_6 Value per kg.U in UF_6 Last Month (Jul 31, 1986)
Australia (dollar)	128.04	78.79	79.36
Belgium (comm. franc)	3,304	2,033	2,108
Canada (dollar)	108.56	66.81	66.74
Finland (markka)	383.10	235.76	242.22
France (franc)	524.19	322.58	330.48
FRG (mark)	159.97	98.44	101.86
Italy (lira)	110,216	67,825	69,958
Japan (yen)	12,165	7,486	7,493
Netherlands (guilder)	180.14	110.85	114.83
South Africa (rand)	210.55	124.03	120.41
Spain (peseta)	10,432	6,420	6,557
Sweden (krona)	539.42	331.95	337.65
Switzerland (franc)	129.05	79.42	81.74
UK (pound)	52.72	32.44	32.34
US (dollar)	78.00	48.00	48.25

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on Aug. 29, 1986.

© NUEXCO 1986

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current Exchange or UF_6 Value	Seller	Buyer	Remarks
3792	1986	301-600	R[2]	Producer	Trader	UF_6.
3790	1987	301-600	R[2]	Producer	Utility	UF_6.
3788	1986	101-300	100	Producer	Utility	
3786	1986	50-100	100	Producer	Utility	
3785	1986	301-600	less than 100	Producer	Utility	

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

© NUEXCO 1986

NUEXCO

CURRENT MARKET DATA

URANIUM SUPPLY
(August 31, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or long-term	Remarks
Available for Sale:			
ACTIVE			
2335	400	—	
2703*	130	—	
		UF_6	
2740	100	—	
2764	260	—	UF_6
2765	260	—	UF_6
2777	500	—	
2885B*	325	—	UF_6
2889	100	—	
2933*	300	300 per year	
2967	100	—	
2973	15	—	
2989	40	—	
3023	500	500	UF_6
3121	1,200	—	
2263	—	400 per year	1987 on
2625	—	500 per year	1987 on
2781	—	250 per year	1988-95
2927	—	220 per year	1987-90
2981	—	600 per year	1988-91
TOTAL:	4,230		
INACTIVE			
2297	200	200 per year	1988-89
2336	250	250 per year	1987-94
2389	75	75 per year	1987-90
2810	195	175	UF_6
2813	30	—	
TOTAL:	750		

*New or revised since last month.
[1] Measured from the date of this Report.
[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2853, 3010.

©NUEXCO 1986

URANIUM DEMAND
(August 31, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2782	600	700	1988
2784	100	—	
2857*	200	300	1988-95
2951	250	100 per year	1987-91
3014*	200	—	
3018*	100	—	
2738	—	1,000	1989-on
2760	—	750 per year	1987-90
3019*	—	200	1988-91
TOTAL:	1,450		
INACTIVE			
2661	250	250 per year	1986-87
2798	70	—	
2877*	300	—	
2893*	200	—	
2681*	—	500	UF_6 or U_3O_8; 1988
2733*	—	500	1988
TOTAL:	820		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2661, 2928, 2934, 3072.

©NUEXCO 1986

NUEXCO

CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(August 31, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2036	500	—	
2667	800	—	
2920	2,000	—	
TOTAL:	5,300		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: None.

No inquiries to borrow are reported this month.

CONVERSION SUPPLY AND DEMAND
(August 31, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2849	550	500	1987-90
2859	750	750	
TOTAL:	1,300		
Inquiries to Purchase:			
ACTIVE			
2833	400	—	
2931*	600	—	
TOTAL:	1,000		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 2974, 2988.

©NUEXCO 1986

SWU SUPPLY AND DEMAND
(August 31, 1986)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2571	—	55	1987
2855	250	—	
3026	15	—	
TOTAL:	265		
INACTIVE			
2410A	340	—	
2873*	40	—	
2953*	200	—	
TOTAL:	580		
Inquiries to Purchase:			
INACTIVE			
2879	250	—	
2878	60	—	
2999*	—	300	
3015*	85	—	
TOTAL:	395		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: None.

©NUEXCO 1986

NUEXCO

ANALYSIS AND COMMENTARY

NUCLEAR ELECTRIC GENERATING CAPACITY FORECAST

The following article presents Nuexco's forecast of nuclear electric generating capacity through the year 2000. Tabular data are presented for the reference case on a country-by-country basis. This article is an example of the analysis used in Nuexco's Uranium Market Study and Price Forecast.

Summary (Reference Case)

Installed nuclear power plant capacity is projected to grow from 230 gigawatts (GWe) at the end of 1986 to 348 GWe by the end of the year 2000.[1] This represents an annual compound growth rate of 2.8 percent, a figure slightly lower than the expected growth in electricity demand. The largest annual additions occur in the early years of the study. Between 1986 and 1990, additions of approximately 14 GWe per year are forecast. This growth pattern is a residual effect of the rash of plant orders that occurred in the early 1970s. By contrast, only approximately 8 GWe per year are forecast to be added between 1995 and 2000; much of that quantity is neither under construction nor ordered, so that figure is considerably less certain than capacity additions projected for the first ten years of the study period. Furthermore, most of this projected growth is concentrated in the few countries that are likely to sustain strong nuclear power programs. Thus, political setbacks in these countries could have disproportionately negative effects on the growth of nuclear power in the later years of the forecast period. Conversely, further negative developments in other countries (such as Finland or Sweden) would have little effect on the Nuexco forecast, except to the extent that they cause premature shutdowns of operating units. Tables 1 and 2 present Nuexco's current forecasts of installed nuclear generating capacity for the 1986 to 2000 period, divided into regions and countries, respectively. Figure 1 presents the information from Table 1 in graph form.

Methodology

Nuexco has considered numerous factors in creating the installed nuclear capacity forecast used in this study. Among these factors are:

— Electricity demand growth rates;
— Political environments;
— Financial strength of operating entities;
— National energy plans;
— Construction experience in each country;
— Operating entities' schedules for completion;
— Construction progress;
— Construction management expertise;
— Licensing backlog;
— Public acceptance of nuclear power;
— Projected plant life.

The relative importance of these factors to the future development of nuclear power varies greatly from one country to another. For instance, in developing countries, financial capability is often the major determinant in scheduling power plant additions. In other countries, such as Japan, the rate of electricity demand growth may be the most important factor.

Europe

Most European countries, which in the past have relied heavily on oil (or, in some countries, hydropower) for electric power generation, have determined that they have no real alternatives to these sources other than nuclear power and coal. Imported coal is costly; and indigenous coal, where available, can be equally expensive. Moreover, in recent years the deleterious environmental effects of coal-generated electricity have become major political issues in some countries. While the Siberian and African pipelines provide natural gas at prices equal to or better than current oil prices, supplies of both natural gas and hydropower in Europe generally are insufficient to provide adequate baseload generation. Thus, based on comparative economics, European nations generally prefer nuclear power as a source of electrical energy. However, public reaction to the Chernobyl accident has greatly strengthened political and societal opposition to nuclear power. Moreover, anti-nuclear forces had already been gaining strength in several countries, so their gains in the wake of the Chernobyl disaster will find expression in more delays and cancellations.

France

By 1990, France will have reduced its dependency on coal and oil to small percentages of overall electricity generation. The vast nuclear power program undertaken in the early 1970s has resulted in France now being dependent on nuclear power for over 60 percent of its electricity. The steady increases in nuclear capacity over the last decade, combined with better reactor performance, have put France well on the way to energy independence. In fact, capacity surpluses seem inevitable, and Electricite de France (EDF) is rapidly becoming a major electricity exporter.

Over the past few years, the growth of the French nuclear program has begun to slow, primarily due to the continuation of

[1]The corresponding figure in Nuexco's forecast as of 1/1/85 was 350 GWe.

© NUEXCO 1986

low rates of load growth and financial problems stemming from loans used to build reactors. Only one new reactor per year will likely be ordered during the period 1986 to 1989. Italy and Spain already take some electric power from France's Tricastin plants as a result of renegotiating their Eurodif enrichment contracts. France can be expected to continue promoting the export of low-cost electricity generated by nuclear power, especially since it will be able to expand its market to the United Kingdom by means of the grid link under the English Channel.

So far during 1986, EDF has put two new PWRs into commercial operation and two other units will probably enter commercial operation by the end of the year. Including the Superphenix commercial demonstration breeder reactor, which was connected to the grid in January of this year, installed nuclear generating capacity in France will total 42.7 GWe. Nuexco expects that figure to grow by 1999 to 69 GWe, approximately 50 percent of Europe's total, and 20 percent of the world total.

Federal Republic of Germany (FRG)

Germany is Europe's largest producer and user of electricity because of its huge industrial base. Oil and natural gas use have been reduced drastically, leaving coal and nuclear-based generation to supply most of the country's needs. The FRG's indigenous coal resources had been the main source of electricity generation until recently. Rapid growth in nuclear capacity in the early 1980s, however, brought a balance to coal and nuclear generation, with each providing about 30 percent of the nation's electricity in 1985.

Three Kraftwerk Union units entered commercial operation during 1985, increasing installed nuclear capacity to 16 GWe. Nuexco expects two additional units, having a combined capacity of 1.5 GWe, to begin commercial operation in 1986. After that time, four more units will increase installed capacity to 22.6 GWe by 1990; a fifth unit will raise installed capacity to 23.8 GWe by 1999 or 2000.

However, the German political situation, especially after Chernobyl, and the resultant regulatory and licensing problems will severely hamper its nuclear program for years, and the climate for new orders and the completion of units under construction appears more unfavorable than perhaps at any other time. One example: local regulatory authorities have promised to deny an operating license for the Kalkar breeder reactor.

The electoral power of the anti-nuclear sentiment raised by Chernobyl will not become evident until the next federal elections in January 1987, and until then several projects either planned or in development by the German nuclear industry will probably not advance. At present, it seems clear that the main opposition party in the FRG, the Social Democrats (SPD), will adopt an anti-nuclear platform, possibly including a call for the gradual phase-out of nuclear power. The Green Party and coal miners' unions will also add to the anti-nuclear forces at work in the FRG. Ultimately, there will almost certainly be pressure within the governing coalition to take concrete steps to moderate the current pro-nuclear policies. Nuexco's reference case forecast does not allow for an election victory by the SPD, but the low case forecast does. It is entirely possible that the current government will withdraw support for one or more controversial projects in a simple effort to retain power in the upcoming elections.

United Kingdom

The United Kingdom has indigenous sources of both oil and coal, the latter usually providing as much as 80 percent of the country's electricity. Although the UK has a diversified generating base, its success with nuclear power performance and capacity has been limited considering the scope of the program. Nevertheless, the AGR program is quickly coming to a close. By January 1986, all but four AGR units were in commercial operation. Two units at Heysham and two at Torness Point are still under construction, but are expected to be operational by 1989.

Following a two-year public inquiry that ended in February 1985, the CEGB is now awaiting the inspector's report on the Sizewell PWR program. This report will be studied by the government and probably debated in Parliament. It is unlikely that any formal decision on the construction of the Sizewell unit can be expected before the end of 1986. Nuexco expects the final decision to be delayed even beyond 1986. It is projected that only one PWR will begin operation by 2000.

Spain

Spain needs nuclear power to reduce its dependency on imported oil, but the Spanish program continues to suffer from problems with the structure of the nation's electricity industry as well as some utilities' weak financial conditions, partly brought on by an ambitious nuclear construction program in the 1970s. In 1984, a new Socialist government reviewed the nuclear program, and five plants under construction were canceled. Later that year, the government and the electricity industry attempted to redistribute ownership of the country's nuclear plants among those utilities in the best financial condition. Nevertheless, a more financially secure electricity industry will be required before additional nuclear plants can be ordered. Two units attained commercial operation in 1985, and two additional units are under active construction. These units are forecast by Nuexco to enter into operation in 1988 and 1989. Two additional units are forecast to begin operation in the 1996-2000 period, a

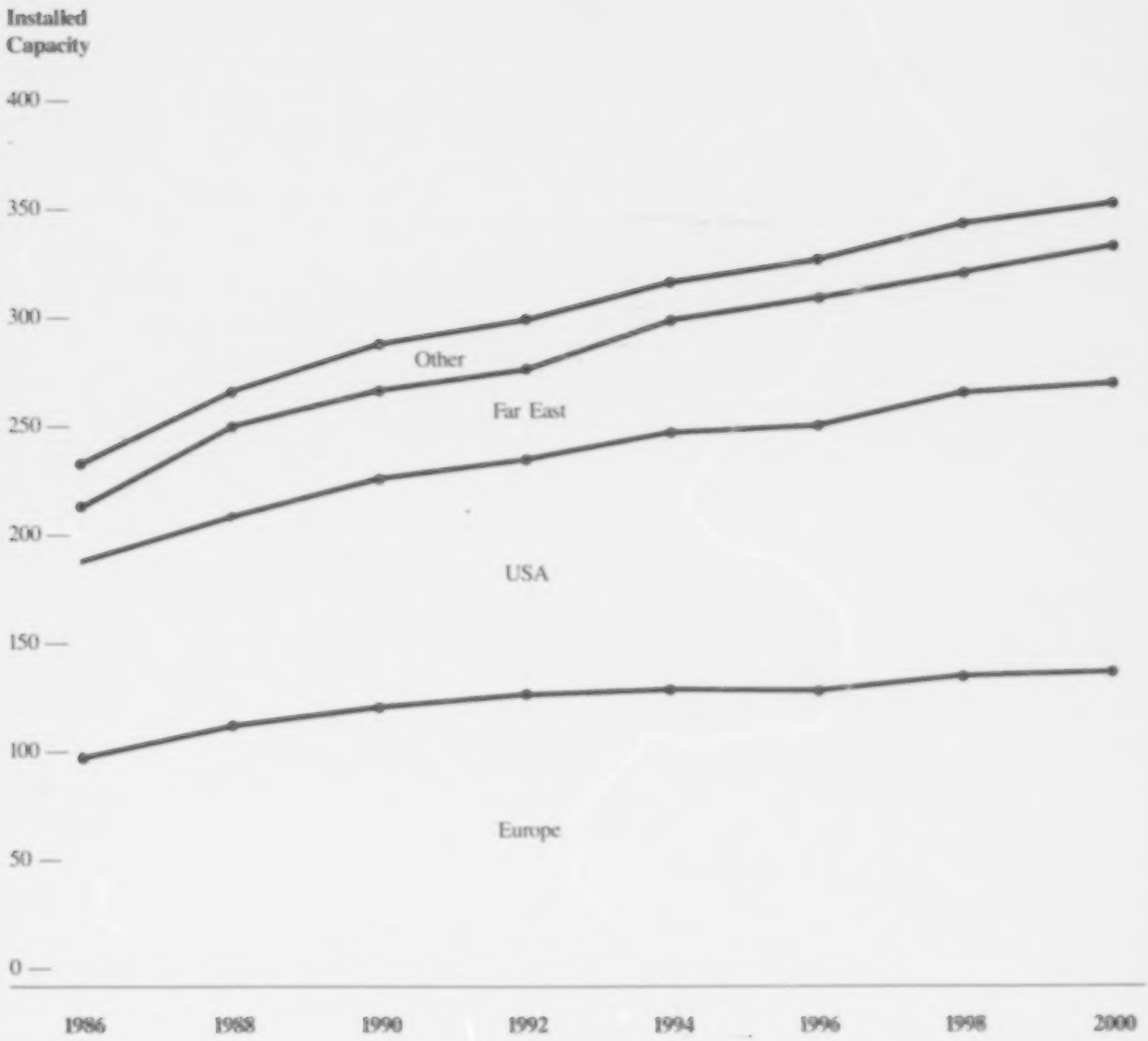
© NUEXCO 1986

NUEXCO

ANALYSIS & COMMENTARY

FIGURE 1

NUCLEAR GENERATING CAPACITY FORECAST
Reference Case
(GWe or Thousands of MWe Net)



© NUEXCO 1986

Table 1

NUCLEAR GENERATING CAPACITY[1] FORECAST
Reference Case
(GWe or Thousands of MWe Net)

Region	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
United States	82.3	90.4	98.0	101.5	105.1	105.1	105.1	106.1	106.1	106.1	105.9	107.1	108.3	108.3	108.3
Europe[2]	98.5	104.1	109.6	115.0	120.0	121.2	125.9	126.8	129.5	129.4	132.9	133.9	140.2	143.3	143.3
Far East[3]	33.1	34.0	38.1	38.1	41.0	42.9	44.0	46.5	47.6	50.1	51.9	54.8	59.9	65.8	69.0
Other Nations[4]	15.9	16.7	17.6	18.5	18.5	19.3	20.9	22.0	23.2	24.1	25.4	26.2	25.8	25.8	27.3
TOTAL[5]	230	245	263	273	285	289	296	301	306	310	316	322	334	343	348

[1]Installed as of year end.
[2]Austria, Belgium, Finland (two Swedish-supplied plants), France, Germany (FRG), Italy, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, and Yugoslavia.
[3]China (PRC), Japan, Korea, Philippines, Taiwan.
[4]Argentina, Brazil, Canada, India, Mexico, Pakistan, South Africa, and Turkey.
[5]Total consists of the nations with nuclear-electric power listed in Footnotes 2, 3, and 4 plus the USA; nuclear-electric nations excluded are Bulgaria, Cuba, Czechoslovakia, Germany (GDR), Finland (two USSR-supplied plants), Hungary, Poland, Rumania, and the USSR. Columns may not add, due to rounding.

© NUEXCO 1986

NUEXCO

ANALYSIS & COMMENTARY

TABLE 2A

NUCLEAR GENERATING CAPACITY FORECAST: 1986-1993
Reference Case
(Electrical Megawatts Net)

REGION	1986	1987	1988	1989	1990	1991	1992	1993
United States	82,306	90,431	98,004	101,524	105,051	105,051	105,051	106,106
Europe								
Austria	—	—	—	—	—	—	—	—
Belgium	5,450	5,450	5,450	5,450	5,450	5,450	5,450	5,450
Finland (TVO only: excludes 2 units supplied by USSR)	1,426	1,426	1,426	1,426	1,426	1,426	1,426	1,426
France	42,738	47,008	49,558	50,833	54,663	55,928	59,738	59,738
Germany (FRG)	17,632	17,632	18,922	21,371	22,601	22,601	22,601	22,601
Italy	1,285	1,285	1,285	1,325	1,325	1,325	2,307	3,289
Netherlands	500	500	500	500	500	500	500	500
Portugal	—	—	—	—	—	—	—	—
Spain	5,637	5,637	6,634	7,616	7,616	7,616	7,616	7,616
Sweden	9,493	9,493	9,493	9,493	9,493	9,493	9,493	9,493
Switzerland	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925
United Kingdom	10,768	12,088	12,748	13,408	13,408	13,358	13,258	13,158
Yugoslavia	615	615	615	615	615	615	615	615
Subtotal Europe	98,469	104,059	109,556	114,962	120,022	121,237	125,929	126,811
Far East:								
China (PRC)	—	—	—	—	—	300	300	300
Japan	23,653	23,653	26,901	26,901	28,766	30,361	31,482	33,999
Korea	4,480	5,380	6,323	6,323	7,266	7,266	7,266	7,266
Philippines	—	—	—	—	—	—	—	—
Taiwan	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924
Subtotal Far East	33,057	33,957	38,148	38,148	40,956	42,851	43,972	46,489
Other Nations:								
Argentina	935	935	935	935	935	935	935	935
Brazil	626	626	626	626	626	626	626	626
Canada	11,118	11,918	12,799	13,680	13,680	13,680	14,561	15,442
Egypt	—	—	—	—	—	—	—	—
India	1,244	1,244	1,244	1,244	1,244	1,464	1,464	1,684
Iran	—	—	—	—	—	—	—	—
Iraq	—	—	—	—	—	—	—	—
Israel	—	—	—	—	—	—	—	—
Libya	—	—	—	—	—	—	—	—
Mexico	—	—	—	—	—	654	1,308	1,308
Pakistan	125	125	125	125	125	125	125	125
South Africa	1,844	1,844	1,844	1,844	1,844	1,844	1,844	1,844
Turkey	—	—	—	—	—	—	—	—
Subtotal Other Nations	15,892	16,692	17,573	18,454	18,454	19,328	20,863	21,964
TOTAL WORLD[1]	229,724	245,139	263,281	273,088	284,483	288,467	295,815	301,370

[1]Includes only those nations that participate in the commercial uranium market. Nations which are excluded are Bulgaria, Cuba, Czechoslovakia, Germany (GDR), Finland (two USSR-supplied plants), Hungary, Poland, Rumania, and the USSR.

TABLE 2B

NUCLEAR GENERATING CAPACITY FORECAST: 1994-2000
Reference Case
(Electrical Megawatts Net)

REGION	1994	1995	1996	1997	1998	1999	2000
United States	106,106	106,106	105,931	107,081	108,294	108,294	108,294
Europe							
Austria	—	—	—	—	—	—	—
Belgium	5,450	5,450	5,450	5,450	5,450	5,450	5,450
Finland (TVO only: excludes 2 units supplied by USSR)	1,426	1,426	1,426	1,426	1,426	1,426	1,426
France	62,488	62,488	63,938	65,208	67,878	69,278	69,278
Germany (FRG)	22,601	22,601	22,601	22,601	22,601	23,831	23,831
Italy	3,289	3,289	3,289	3,289	4,264	5,089	4,829
Netherlands	500	500	500	500	500	500	500
Portugal	—	—	—	—	—	—	—
Spain	7,616	7,616	8,591	8,591	9,566	9,566	10,563
Sweden	9,493	9,493	9,493	9,493	9,493	9,493	9,493
Switzerland	2,925	2,925	2,925	2,925	3,850	3,850	3,850
United Kingdom	13,058	13,008	14,108	13,832	13,532	13,212	12,437
Yugoslavia	615	615	615	615	1,615	1,615	1,615
Subtotal Europe	129,461	129,411	132,936	133,930	140,175	143,310	143,272
Far East:							
China (PRC)	300	300	300	1,200	2,100	2,100	2,100
Japan	35,120	37,566	39,395	40,440	42,782	45,917	47,271
Korea	7,266	7,266	7,266	8,209	9,152	10,095	11,038
Philippines	—	—	—	—	—	—	—
Taiwan	4,924	4,924	4,924	4,924	5,824	7,674	8,624
Subtotal Far East	47,610	50,056	51,885	54,773	59,858	65,786	69,033
Other Nations:							
Argentina	935	1,627	1,627	1,627	1,627	1,627	1,627
Brazil	1,871	1,871	3,116	3,116	3,116	3,116	3,116
Canada	15,442	15,442	15,442	15,442	15,442	15,442	16,342
Egypt	—	—	—	—	—	—	—
India	1,684	1,904	1,904	2,124	1,724	1,724	1,724
Iran	—	—	—	—	—	—	—
Iraq	—	—	—	—	—	—	—
Israel	—	—	—	—	—	—	—
Libya	—	—	—	—	—	—	—
Mexico	1,308	1,308	1,308	1,308	1,308	1,308	1,308
Pakistan	125	125	125	125	125	125	125
South Africa	1,844	1,844	1,844	1,844	1,844	1,844	1,844
Turkey	—	—	—	629	629	629	1,229
Subtotal Other Nations	23,209	24,121	25,366	26,215	25,815	25,815	27,315
TOTAL WORLD[1]	306,386	309,694	316,118	321,999	334,142	343,205	347,914

[1]Includes only those nations that participate in the commercial uranium market. Nations which are excluded are Bulgaria, Cuba, Czechoslovakia, Germany (GDR), Finland (two USSR-supplied plants), Hungary, Poland, Rumania, and the USSR.

©NUEXCO 1986

result of deferrals that were forced when the government announced its national energy plan in 1984.

Italy

Italy is heavily dependent on imported oil and needs alternate sources of energy, including a much stronger nuclear power program to help it diversify its electricity sources. After much ambitious planning, the Italian nuclear program has been at a standstill; only three units are in operation. However, in late 1985, Italy's state utility, Ente Nazionale per l'Energia Elettrica (ENEL), took the first positive step in twelve years toward the expansion of its installed capacity when it signed a contract with Ansaldo Meccanico Nucleare SpA, an Italian reactor supplier, to build two PWRs at the Trino Vercellese site. ENEL last ordered a reactor in 1973, when it contracted for the two Montalto di Castro BWRs. Italy's current installed nuclear capacity amounts to approximately 1.3 GWe, but is projected to grow to 4.8 GWe by the year 2000. However, in the aftermath of the Chernobyl accident, Italy's parliament called a National Conference on Energy for this fall, and ENEL is likely to substitute coal for any further nuclear expansion. For example, siting procedures and construction plans for proposed reactors in Lombardy and Puglia will likely be suspended, at least until the outcome of the conference.

Sweden

The final two units of Sweden's nuclear construction program entered commercial operation in 1985. With those additions, nuclear power provides approximately 50 percent of Sweden's electricity. Current installed capacity amounts to 9.4 GWe. However, Swedish law requires the development, in the 1990s, of a schedule which will provide for the decommissioning of all 12 plants by 2010. Nuexco had expected that future political developments in Sweden would repeal, or at least delay, the 2010 deadline. However, the country's reaction to the Chernobyl disaster has practically eliminated that possibility for the foreseeable future.

Belgium

Belgium has the second lowest electrical rates in the European Community, and France is the only European nation more dependent on nuclear power than Belgium. This current phase of 5.4 GWe installed capacity accounts for 80 percent of Belgium's electricity production. In addition, Belgium has financial interests in nuclear projects in Germany (Kalkar) and France (Chooz and Superphenix). During 1985, the final two units of its current program began commercial operation. Although planning may be underway for a possible fifth unit at the Doel site, at present Nuexco expects no new reactor orders for Belgium during the period of this study.

Switzerland

Switzerland's increasing difficulty in expanding hydropower utilization will place added pressure on a nuclear power program that may be losing public support, especially after Chernobyl. While the Swiss generally have been in favor of nuclear power, building a successful program that accounts for about 45 percent of the nation's electricity, the marginally pro-nuclear results of a 1984 referendum and fierce local opposition have reduced the likelihood that the next planned unit, Kaiseraugst, will be built. Five units are currently in operation, producing about 2.9 GWe; operation dates are indefinite for the planned Kaiseraugst and Graben units.

The Netherlands

Two units, totaling 500 MWe, are in operation in the Netherlands. Public opposition to an increase in the Dutch nuclear program has intensified since Chernobyl, but the possibility remains that the government will order another unit in the 1990s. Nuexco expects no increase in nuclear generating capacity through 2000.

Austria

It now appears certain that the completed Zwentendorf reactor will never be allowed to operate. Public opinion toward nuclear power, never favorable in Austria, worsened substantially following Chernobyl, making it politically unfeasible that the nuclear option will be exploited, at least for the rest of this century.

The Far East

The growing industrial and manufacturing sector in the Far East requires major commitments to electricity production. Traditionally, the Far East has been heavily dependent on imported oil. Indigenous coal resources are scarce, so these countries must import coal as well. Nuclear power is, therefore, important in these countries; its adoption has been accelerated partly in response to load growth and partly to replace oil-fired plants.

Japan

During 1985, four units entered commercial operation, increasing installed nuclear capacity to 23 GWe. One unit was scheduled to begin commercial operation in 1986, Kyushu Electric Power Company's 846-MWe Sendai Unit 2, and it did so in the first half of this year. By the year 2000, Nuexco forecasts an installed nuclear generating capacity of approximately 52 GWe, a compound growth rate of over 5.6 percent per year. These figures are, however, somewhat more conservative than those established by the Ministry of International Trade and Industry (MITI) in 1984 and confirmed in 1985. MITI's forecast of installed nuclear capacity reaches 62 GWe in the year 2000. Nuexco's forecast is lower due to our somewhat more pessimistic

©NUEXCO 1986

assessment of siting constraints, licensing constraints and load growth projections.

Korea

Korea has brought two nuclear units into commercial operation during 1986, and now has six commercial nuclear units, comprising a total net generating capacity of 4.5 GWe. Korea Electric Power Company will complete a seventh unit, Korea Nuclear Unit 8, during 1987. Two other units already in advanced stages of construction will be completed this decade, bids have been invited on two more units scheduled to be operating by 1998, and Nuexco also projects orders for two to seven more units. If four of those units enter commercial service by the year 2000 as projected, they will increase Korea's installed nuclear capacity to 11 GWe. Even if those expectations are not all met, Korea will still maintain a strong nuclear power construction program throughout the remainder of this century.

People's Republic of China (PRC)

The PRC continues to pursue plans for an ambitious nuclear program, although officials recently scaled back plans calling for 10,000 MWe of nuclear generation by the year 2000. The current plan calls for 6,000 MWe by 2000, utilizing a combination of 300 MWe, 600 MWe, and 900 MWe units. Plans for two units at Sunan have been postponed indefinitely. Nuexco expects the 300-MWe Qinshan unit, currently under construction, to enter commercial operation in the early 1990s. The two 900-MWe Daya Bay (Guangdong) units are expected to enter service in the late 1990s. Thus, Nuexco forecasts approximately 2.1 GWe to be operational at the end of the study period.

The Philippines

The status of the Philippines' 620-MWe PWR is officially categorized as indefinite, but strong opposition to the plant's operation, including that of President Corazon Aquino, will almost certainly prevent its operation.

Taiwan

For Taiwan, the latest addition marks the end of the present program, principally due to the effects of lower-than-expected economic growth. However, due to expected increases in electricity consumption and economic growth in the 1990s, Nuexco projects a resumption in ordering and the addition of three new plants between 1996 and 2000 for a total installed capacity of 8.6 GWe by the end of the period.

The United States

Financial constraints, diminishing load growth, licensing problems, and meager public support continue to plague the US nuclear industry. Nevertheless, there have been signs in the last few years that indicate a recovery from the problems of the post-Three Mile Island period. Foremost among them is the fact that no units were canceled in 1985, an event that last occurred in 1973. Yet it is almost certain that no new units will be ordered before 2000, mainly due to financial and licensing constraints. Thus, all nuclear capacity additions through the year 2000 will come from plants currently under construction. Moreover, after considering the long construction cycles commonplace in the USA, it is virtually certain that plants not yet under construction in the USA will not be able to begin commercial operation during this century.

US installed capacity of 74 GWe at the beginning of 1986 has already been augmented by three units having a combined capacity of 3.4 GWe; four other units should enter commercial operations, raising the US installed nuclear capacity to 82.3 GWe, by the end of this year. Further additions to capacity will raise the US total to 105.1 GWe by the end of 1990; that figure will be approximately 37 percent of the world total. However, increases in the next decade will be only 3.2 net GWe, so the US portion of the world's installed nuclear capacity will decline to only 31 percent. After that time, decommissionings will begin to reduce US capacity unless other nuclear units are brought into service. Technical improvements could extend plant lifetimes, but that would only postpone for a few years the effect of decommissioning.

There is a possibility of resuming construction on some of the canceled or indefinitely delayed (but partially completed) nuclear power plants. If the obstacles to such resumptions of construction could be overcome, the units might be completed promptly. However, utility experience with these plants has usually been financially disastrous, publicity has been negative, quality assurance programs are incomplete and retrofit programs would be required to upgrade the technology. In general, Nuexco has discounted the likelihood that construction on any of those deferred units will resume. However, one notable exception is apparent. Philadelphia Electric Company has resumed construction on Limerick Unit 2, now scheduled for completion in 1991.

In establishing our forecast of dates for commercial operation, Nuexco generally used data pertaining to individual operating entities and individual power plants, rather than applying nominal figures over an entire region or reactor type. In a few cases in the USA, however, where adequate information specific to an individual case was not available, Nuexco used a nominal construction schedule. In that event, the units were placed on a 7-year construction cycle (in a so-called S-curve) which relates plant status to year of commercial operation as follows:

© NUEXCO 1986

Time to Commercial Operation of Nuclear Plants Under Seven-Year Construction Schedule

Plant Status	Current Construction Completion (%)	Year of Commercial Operation
Under Construction	100	1986
" "	90 to 99	1987
" "	75 to 89	1988
" "	55 to 74	1989
" "	30 to 54	1990
" "	15 to 29	1991
" "	7 to 14	1992
" "	0 to 6	1993

This schedule may be slower by up to four years than the scheduled completion dates announced by the respective utilities. Nevertheless, it is an ambitious schedule when compared to past results in the USA.

Although the current outlook for longer-term growth of nuclear power in the USA is poor, 1985 proved to be a relatively encouraging year. No nuclear plants were canceled during the year, whereas eight units were canceled in 1984. Some might consider 1985 as a transition year for nuclear power. However, even though the Chernobyl accident will adversely affect only a few US units in the near term, it will postpone even further any resurgence of US public acceptance of nuclear power in the long term.

Other Nations

The *Other* category has been changed from previous editions of the market study. The North American region has been replaced by the USA, and Canada and Mexico are now included among the *Other Nations* category. Nuclear power growth in these countries will continue to be gradual. Nuexco forecasts that an installed nuclear capacity of 14.6 GWe at the beginning of 1986 (15.9 GWe by the end of 1986) will grow at an annual compound rate of 4.2 percent, to 27 GWe in the year 2000.

Countries in this category, other than Canada, have electrical demands and distribution systems that are not well suited for today's large commercial designs. While some reactor vendors are looking at smaller designs (300 MWe) for such applications, several factors continue to deter the development of nuclear programs, including:

— the complexity of current nuclear power plant designs;
— the difficulty of financing relatively large projects;
— the need for trained operating staff.

Canada is approaching the completion of its current phase of nuclear power deployment. Two units have entered commercial operation in 1986, bringing the nation's total installed capacity to 11.1 GWe. Five other units now under construction will probably enter operation by the end of 1993, raising the nation's nuclear capacity to 15.4 GWe. One projected future order could enter commercial operation during the year 2000, raising the total to 16.3 GWe.

The prospect of exporting power to the northern USA has been a significant factor in the growth rate of the Canadian nuclear program. However, prospects for such exports have declined of late, as load growth projections have been reduced in the USA. As a result, waning interest on the part of US utilities in the northeast that had been expected to invest in Point Lepreau Unit 2 has made the unit's construction uncertain. Absent any investment on the part of US utilities, it is doubtful the unit will be built during the study period. In addition, declining electricity demand and rising construction costs probably will continue to hinder new plant orders and construction in Canada.

India placed one unit into commercial operation in 1985. While installed nuclear capacity is expected to remain small, India's program probably will continue to develop steadily as four units now under construction, each 220 MWe, come into operation in the 1990's. *Argentina*, *Brazil*, *Mexico* and *Turkey* (which is projected to have two units in operation late in the 1990s), all have small, very slowly developing nuclear power programs that are limited primarily by the nation's ability to finance or obtain financing for nuclear plant construction.

Two countries in this category, *Pakistan* and *South Africa*, have some installed nuclear capacity, but are not expected to add more capacity during the period of the study. *Egypt*, *Iran*, *Iraq*, *Israel* and *Libya* all have considered initiating nuclear power programs, but none are expected to begin any commercial construction operations during the period. However, these countries are included in the tabular data.

© NUEXCO 1986

COMMENTARY

THE SPOT MARKET AND THE SPOT PRICE: APPLICABILITY AND LIMITATIONS

by
George White, Jr.
Managing Broker, Nuexco

The following slightly edited presentation was given by George White, Jr., Managing Broker of Nuexco, at the Uranium Institute's Eleventh Annual Symposium in London, September 4, 1986.

The general subject of spot prices and their relationship, if any, to long-term contracts raises numerous issues. Today I would like to address the latter, which I believe to be the more important of those issues. To provide a framework for what follows, I need to share a bit of history with you. The original name of our company was to be Nuclear Bank Corporation. We found, however, that the use of the word "Bank" in the corporate name made us subject to certain US laws regulating the banking industry. The name was quickly changed to Nuclear Exchange Corporation, and we promptly began to refer to ourselves as Nuexco, and the name was officially changed to Nuexco in 1977.

I am often asked "Where in the world did you come up with the term Exchange Value? Why not Spot Price or Spot Value?" Recall the company name was Nuclear *Exchange* Corporation. We were a new company and proud of the name. And, as some of you may recall, Nuexco was organized to engage in the business of arranging uranium loans. The idea was simple and akin to the banking business. Those who had too much uranium could deposit their excess in Nuexco's "bank." Those who had short-term needs could borrow from this uranium "bank," paying interest to the depositor whose uranium was borrowed and a small fee to Nuexco for its services in arranging the loan. Naturally, the borrower had to replace the uranium it had borrowed. Since it was unlikely that the borrower could repay the *exact* number of pounds borrowed, Nuexco published a value that was intended for use in settling the loan when the quantity of uranium repaid was slightly more or slightly less than the quantity borrowed.

At that time, Nuexco's value was the only immediate price indicator available. In all markets, buyers and sellers look for reference points to assure themselves they are not paying too much or receiving too little, so as to justify the prudency of their actions. In time, some uranium buyers and seller began to use the Exchange Value to price spot market uranium transactions. Eventually, the Exchange Value came to be used in longer-term contracts, usually as a base price which was subject to escalation for deliveries in later years. Still later, long-term delivery prices were simply defined as functions of the Exchange Value, in some cases subject to floor or ceiling prices.

We at Nuexco were somewhat surprised by these developments. In fact, we were flattered by what had been achieved, albeit more by accident than design. We also became increasingly sensitive to the responsibility thus acquired. Procedures and record keeping grew more formalized. Credibility became a matter of the greatest concern. Consequently, *nothing* that Nuexco does in its business is viewed more seriously than establishing those monthly values.

Some interesting things happened to Nuexco during those years. To our dismay, we found ourselves involved in just about every instance of uranium litigation, and we had the dubious pleasure of spending days in front of the federal grand jury conducting the 1976 antitrust investigation of the uranium industry. As spot prices surpassed the US$40 level in the latter half of the 1970s, some utilities became concerned that Nuexco was a "tool" of the uranium production industry. It was suggested that a less subjective, less judgmental measure of spot prices was required. In 1978, at this meeting, I announced the publication of a new price series, the Transaction Value, which we still publish. However, during the period 1975 to 1980, I do not recall any uranium producer ever expressing the *slightest* concern about the influence of the Exchange Value on long-term contracting. Quite the contrary, they were delighted and were quick to point out the validity and credibility of the Exchange Value.

But, as might be expected, spot prices started to decline and the uranium producers suddenly became concerned that Nuexco was a "tool" of the utility industry. That illustrates an important question — what exactly is the Exchange Value? The straightforward answer is that the Exchange Value is simply as it is defined. An easier answer is that the Exchange Value is merely an indicator of the level of spot market prices. However, an opposite approach notes what the Exchange Value definitely is not. Specifically:

— It does *not*, in any way, measure, indicate, or provide any information about uranium production costs nor, by extension, about the prices at which future supplies of uranium should be sold in order to justify investment in new production facilities.

— It provides *no* information with respect to prices being paid for uranium that is being delivered today under contracts entered into at earlier dates.

— It provides *no* information nor judgment about correct, appropriate, economic, or fair prices for uranium.

In the past, Nuexco has gone to considerable lengths in our Monthly Report, special reports, and numerous papers to make these points clear. As spot uranium prices rose rapidly during the mid and late 1970s, a great deal of uranium was sold under

© NUEXCO 1986

COMMENTARY

contracts with base-escalated or spot market related pricing provisions. Often the base price was at or near the level of spot prices as of the date the contract was signed. These contracts were particularly prevalent in the United States. Base prices of US$30.00 to $40.00 per pound U_3O_8 were commonplace. With the high inflation experienced during those years, the escalation factors drove actual delivery prices rapidly upwards to US$60.00 to $70.00 per pound, and in some cases even higher. Of course, the bulk of these deliveries were made just as spot prices declined. The comparison between a current delivery price of US$60.00 per pound U_3O_8 under a long-term contract and the current spot price level of about US$17.00 is dramatic and a source of considerable embarrassment for the utilities involved.

The response of many utilities, particularly in the USA, was to get out of those contracts as fast as possible. Some negotiated terminations with their suppliers; others went to court, filing lawsuits to break the contracts. Many adopted policies against entering contracts, the pricing provisions of which could operate so as to cause them to pay more than spot market prices for uranium. The driving force for most US utilities was and continues to be Public Utility Commission criticism and the threat of being unable to recover, through rate adjustments, uranium costs that are in excess of spot-market prices.

Historically, non-US utilities have been less concerned about possible divergences between spot prices and those being paid under long-term contracts. The primary reason is that, lacking domestic uranium production capability, they and their regulators are relatively less sensitive to short-term pricing trends and more sensitive to long-term supplier relationships and the associated security of supply considerations. However, there are notable exceptions to this general rule. Some non-US utilities now face the unwelcome prospect of taking delivery of uranium under long-term contracts at prices well in excess of current spot price levels and then being required to mark it down to spot-market levels, producing immediate accounting losses.

Indeed, the decline in spot-market prices has affected the entire uranium industry. Despite assertions that they operate in an environment that is independent of the spot market, it has affected those producers that have historically negotiated prices on a year by year basis. It has affected those attempting to win supply contracts to base load new production facilities. It has altered the procurement philosophy of a number of utilities. Even if Nuexco and Nukem ceased publishing their values today, the situation would not change. Someone else would begin to publish price indicators tomorrow.

Much has been said and written about disassociating spot prices from long-term contracts, but little has been accomplished. The idea of a broadly accepted, fair market price for deliveries under long-term contracts remains an illusion, despite its appeal. Despite the fact that is has been contemplated in many contracts, no such price exists today. In my judgment, is it not likely to exist in the future. In fact, I believe that the uranium market is moving in exactly the opposite direction — towards stronger links between spot prices and long-term contracts. Uranium is in the process of becoming a commodity, and spot market-based, commodity-type pricing will become the norm.

In support of this contention I note the following:

— First, while US utilities have historically been and remain the most insistent on spot-market-related pricing features in long-term contracts, it is evident, based on recent requests for proposals, that utilities in other countries are showing increased interest in such provisions.

— Second, an analysis of uranium pricing presented by Nuexco's Jim Vaughan at the Atomic Industrial Forum's Fuel Meeting in March 1985 indicated that, during 1983, 18 percent of uranium deliveries were at spot-market-related prices. For 1984 deliveries, the figure was 21 percent. We have since updated that analysis, and the figure for 1985 increased to slightly more than 28 percent. Moreover, the figures for all three years would have been higher by 10 to 13 percentage points had we included those deliveries that would have been made at spot-market-related prices *except* for the operation of floor-price provisions. Thus, in 1985 more than *40 percent* of all uranium effectively was delivered under spot-market-related contracts. While three years of data do not constitute a proof, a definite trend has become evident. In addition, the increasing percentages are impressive, particularly when compared to the common misconception that only about 10 percent of uranium is traded at spot prices.

— Third, contrary to prevailing conventional attitudes, it is clear that uranium demand is price-elastic. In a paper presented here last year, Phillip Crowson pointed out the difference between elasticity of demand and elasticity of requirements. I believe that the difference is perhaps even greater than suggested by Mr. Crowson. Specifically, the existence of large inventories has increased the price elasticity of uranium demand. Consider the following points:

— As of the end of 1985, uranium inventories held by commercial entities exceeded 475 million pounds U_3O_8 equivalent.

— During the seven years 1979-1985, when prices were declining or low, production exceeded consumption in each and every year, and total additions to inventory exceeded 200 million pounds U_3O_8.

— The clearing of excess inventory overhang from the spot market began in 1979 and was confidently predicted by most observers to be a short-term affair that would run its course in a few years. That process is now in its eighth year.

— Finally, despite past and present forecasts of uranium

©NUEXCO 1986

production and consumption, we do not anticipate any significant reductions in the absolute size of inventories in the next decade. As Mr. Crowson also noted in his paper, those expressing concern about possible future shortages of uranium tend to ignore the behavior and motivations of mining companies which come under very strong pressure to exploit promising orebodies, regardless of the prevailing state of the market.

I am aware that this view of future uranium pricing provides little solace to some current and would-be uranium producers. Most observers would agree that in the longer term, and ignoring historically short-term fluctuations in exchange rates, a price of US$17.00 per pound U_3O_8 (in constant 1986 dollars) will not provide the requisite worldwide incentive for the development and exploitation of the reserves needed to meet longer-term uranium requirements. The problems and risks associated with pricing long-term delivery commitments at spot-market-related levels are well known and have been discussed in this and other forums at great length.

In actuality, however, an increasing number of buyers are insisting on spot-market-related pricing, and more uranium is being delivered at such prices, even though such prices may not bear any meaningful relationship to uranium production costs. The change has been gradual and is likely to continue as such. Moreover, to the extent that potential sellers are unwilling or unable to agree to such pricing terms, buyers will eventually seek sellers who will agree to those terms. Some buyers and sellers can be expected to resist strenuously and continue to price uranium with relatively less consideration to what is happening in the spot market. However, as their numbers decrease, and as ever increasing quantities are delivered at spot-market-related prices, theirs will be an increasingly difficult position to maintain.

In closing, I quote from Mr. Crowson's paper. Speaking of uranium in comparison with other metals and minerals, he notes:

> "Granted it does have many special, even unique, features, uranium is nowhere near as atypical as is often claimed. The similarities with minerals, including the other energy minerals, are much closer than is usually acknowledged..."

© NUEXCO 1986

NUEXCO

RECENT DEVELOPMENTS

AUSTRALIA

In Report 216 (August 1986, page 23), Nuexco noted that at the National Labor Party Conference, the government had voted to continue its ban on uranium shipments to France until that country ceased testing nuclear weapons in the South Pacific region. Since 1984, that ban had directly affected shipments of uranium under a contract between Queensland Mines Ltd. and Electricite de France. In late August, however, the Australian government decided to abandon that policy as a consequence of increasing budgetary pressures and the recognition that the ban had had virtually no effect on French policy and stood no chance of altering that policy in the immediate future. The government estimated that its expenditures required to purchase the Queensland Mines uranium originally destined for EDF would have totaled A$66 million, including about A$25 million during this fiscal year. A resumption of deliveries would remove the need to expend the latter sum, and might make possible the recovery from EDF of those amounts expended in past years for the 800 metric tons U_3O_8 already purchased by the Australian government.

Since EDF holds large uranium supplies independent of the Australian deliveries, the only consequence of banning the Queensland Mines shipments has been to penalize Australia financially. While the announcement probably will cause some political embarassment for the Australian government, the timing of the decision was based on economic necessity, and the economic relief undoubtedly will be welcomed. The move could also have the ancillary benefit of opening France as a potential market for the Olympic Dam (Roxby Downs) material.

The following comments are excerpts from the press release issued on August 19, 1986 by the Minister for Energy and Resources:

"The government has decided, after carefully balancing all relevant considerations, to lift the embargo on exports of uranium to France which was introduced in 1983. This decision...was taken in the light of the need to explore every available avenue to achieve spending reductions and revenue returns. It has significantly limited the extent of cuts the government was forced to make in other areas, including welfare."

"The government will save A$25.4 million in 1986-1987 by not purchasing uranium from Queensland Mines, and will receive a further A$40.8 million through repurchase of uranium bought by the Commonwealth from QML last year as a result of the ban. Another A$0.2 million will come from the uranium export levy on this material. The lifting of the embargo will also produce longer-term benefits, with further budget savings...and from opening of the French market for further exports of Australian uranium for peaceful purposes."

"The embargo...has not pushed France towards ceasing nuclear weapons testing in the South Pacific. There was never any possibility of other uranium suppliers joining the Australian embargo against France, and no real prospect at any stage of France being economically hurt by our actions. The only impact of the embargo on France to date has been to relieve it of the obligation to take contracted Australian uranium at higher than spot-market prices."

* * *

Two exploration companies signed the first agreement with Aboriginal landowners for mineral exploration in the Northern Territory since the Aboriginal Land Rights Act was passed in 1976. Kumagai Gumi Company Ltd., a Japanese exploration and construction company, and Uranerz Australia Pty. Ltd., a subsidiary of the German uranium production company, have formed an equal-share joint venture for exploration in Australia. The agreement gives the joint venture partners the rights to mine on a 65-square kilometer area of West Arnhem land in the Northern Territory. The area is near the Nabarlek uranium mine, and is believed to contain substantial reserves of uranium, gold, platinum, and tin.

Over 150 companies had been competing for the rights to exploit the area. The Northern Land Council negotiated the agreement, and following the announcement emphasized that Aboriginal landowners were not averse to mineral development on their land provided their concerns are taken into consideration. Both of the companies involved in the joint venture appear to be interested in the area in order to diversify their sources of supply. However, the precise mining terms of a given ore deposit will probably not be negotiated until exploration results are known. Moreover, until the political climate of the Northern Territory and the federal government become more receptive to uranium mining and sale, the partners are not likely to realize any short-term commerical benefit from the agreement.

UNITED STATES

Introduction

Several legislative proposals currently under review in the US Congress could strongly affect the international nuclear fuel market in the coming months. The following summary examines the present status of these measures, some of which concern US trade with South Africa, and others that deal with the viability of the US uranium production sector or DOE's attempts to impose new criteria governing its enrichment program. It is important to note that each of these measures is subject to review by various committees in the Senate and House of Representatives, so the details of any particular piece of legislation can undergo major revisions, sometimes in a matter of days.

© NUEXCO 1986

South African Uranium

On the strength of public pressure to impose stricter sanctions against South Africa's government because of its apartheid policies, several bills designed to restrict trade between the USA and South Africa have been introduced in Congress over the last few years. In September 1985, President Reagan avoided signing a bill that would have brought trade restrictions against South Africa, choosing instead to issue an executive order that accomplished some of the same goals but imposed less harsh measures. Over the last few months, however, new concern has developed following the South African government's recent reimposition of a state of emergency. In May 1986, Senator Edward Kennedy (D, Massachussetts) proposed the Anti-Apartheid Act of 1986 (S. 2498), which was never brought to the floor of the Senate. Among other restrictions, the bill would have banned the importation of uranium, coal, and steel from South Africa. Two months later, elements of the Kennedy bill were incorporated into Senator Richard Lugar's (D, Indiana) legislation (S. 2701), which was referred to the Committee on Foreign Relations. Shortly thereafter, the Lugar bill was passed by the Senate, and must be passed by the House of Representatives and signed by the President before it can become law. The bill also contains language that would ban the importation of uranium, as follows:

> "Sec. 311(a) Notwithstanding any other provision of law, no uranium ore, uranium oxide, or coal that is produced or manufactured in South Africa may be imported into the United States. This section shall take effect 90 days after the date of the enactment of this Act."

Importantly, there are no provisions stated in this act which provide for the grandfathering of existing contracts, although there appear to be no restrictions on any South African origin uranium presently in the USA. Moreover, the language bluntly prohibits *any* importation of South African uranium ore or oxide, regardless of whether it is intended for use in the USA or will only be converted or enriched in the USA. Thus, if the bill becomes law, non-US utilities would be unable to enrich South African uranium (that is not already in the USA) at DOE's enrichment facilities. At present, it is unclear how the proposed law would treat the UF_6 resulting from conversion of South African U_3O_8 at a non-US converter.

Concurrently, members of the House of Representatives were drafting legislative sanctions against the South African government. H.R. 4868 was introduced in May by Representative William Gray (D, Pennsylvania) and 30 cosponsors. It was subsequently referred to the Committees on Foreign Affairs; Ways and Means; and Banking, Finance and Urban Affairs. The House was expected to pass the bill, but instead it approved a stricter substitute bill proposed by Representative Ronald Dellums (D, California). Far more stringent than the Senate bill, this legislation effectively would ban all trade with South Africa as well as US investment in the country. The bill would take effect 180 days after being passed into law. The ban would extend to the importation of uranium ore and uranium oxide using the following language:

> "Notwithstanding any other provision of law, no article which is the growth, produce, or manufacture of South Africa may be imported into the United States, except for those strategic minerals of which...the quantities essential for military uses exceed reasonably secure domestic supplies...

It is unlikely that US uranium would be deemed so scarce that it could not adequately supply US military needs. Rather, such minerals as chromium and manganese, which are used in the production of aircraft and other military hardware, are more likely to fall into that category because of their scarcity outside of South Africa. Therefore, it is reasonable to conclude that uranium imports would be prohibited by the embargo terms specified in the bill.

The sanctions package presented by the House is so radical that if passed by the Senate, it would almost certainly be vetoed by President Reagan. The Senate bill, however, seems to have wider support within the Congress. For example, some observers noted that many conservative Republicans in the House of Representatives may have voted for the harsher House bill only because they felt certain it would not become law. Because similar bills were passed by both houses of Congress, it will be up to a conference committee to decide the form of a compromise bill to be presented to Reagan for his signature.

Although President Reagan continues to express his opposition to sanctions, the strong sentiment in Congress may be sufficient to override or even forestall a veto. However, Reagan might be able to circumvent the issue by vetoing the compromise bill presented to him while concurrently issuing an executive order containing some punitive action against South Africa. In this manner, any pressure on South Africa could be tailored to the philosophy of the Administration, while perhaps appeasing enough members of Congress to assure that his veto of the harsher compromise bill would be sustained. This was essentially the process that occurred in September 1985, when Reagan's executive order, among other things, prohibited shipments of nuclear equipment or technology until South Africa agreed to the terms of the Nuclear Nonproliferation Treaty.*

Domenici Legislation

The Uranium Revitalization and Tailings Reclamation Act of 1986, first introduced into Congress in April by Senator Pete

*In actuality, such exports are already forbidden by US law, by virtue of the fact that South Africa has not signed the Nuclear Nonproliferation Treaty.

© NUEXCO 1986

Domenici (R, New Mexico), is currently undergoing revision. The terms of the bill as it appeared in April are examined in detail in Report 215 (July 1986, page 5). Its major points are the imposition of a 50-percent embargo on US utilities' use of foreign-origin uranium; the write-down of DOE's enrichment debt to only $350 million through FY1986; the approval of DOE's Utility Services Enrichment Contract; and the formation of the Uranium Mill Tailings Fund to subsidize the reclamation of mill tailings sites across the country.

Presently, the legislation resides in Senator McClure's Committee on Energy and Environment. The bill probably will be reintroduced to the full Senate when it returns from recess in September. At that time, the bill is likely to be published in its revised form in the *Federal Register*; until then, it is difficult to speculate on its latest provisions.

DOE's Proposed Enrichment Criteria

An article in Report 216 (August 1986, page 12) examined DOE's proposed criteria governing uranium enrichment, which were released (in draft form) for review and comment during the first half of 1986. In late July, when the final wording was established, the proposed criteria were submitted to Congress by DOE for the required 45-day review. Congress must enact legislation or adopt a joint resolution opposing the criteria within the 45-day period in order to prevent the proposed changes from taking effect. Absent action from Congress during the 45-day period, the proposed criteria would have acquired the force of law.

In early August, the US Senate passed a joint resolution prohibiting DOE from providing enrichment services under the terms of the proposed criteria. The resolution (Joint Resolution 668) was sponsored by Senator Domenici, and the bill to which it was attached is necessary to increase the statutory limit on the public debt. Thus the bill with the amendment disapproving the new criteria, although it must go back to the House of Representatives for review, will almost certainly pass. However, the House could strip the debt bill of any or all of its amendments, including the one pertaining to enrichment criteria, before it is forwarded to the President for his signature.

Shortly after the Senate amendment was passed, Representative Bill Richardson (D, New Mexico) and eight other sponsors introduced in the House a separate resolution disapproving the criteria. House Joint Resolution 699 was immediately referred to the Committees on Energy and Commerce and on Interior and Insular Affairs. A subcommittee of the former, the House Energy and Commerce Subcommittee on Energy, Conservation and Power (chaired by Rep. Edward Markey) acted favorably on the resolution. The resolution simply states:

> "Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, that the Secretary of Energy may not provide uranium enrichment services under the terms and conditions of the criteria that, on July 24, 1986, were submitted to Congress pursuant to section 161(v) of the Atomic Energy Act of 1954 (42 U.S.C. 2201 (v)) and, on July 29, 1986, were published in the Federal Register (51 Fed. Reg. 27132)."

Sponsoring Congressmen in the House and Senate gave similar reasons for the introduction of the resolutions. In particular, Senator Domenici argued that although DOE provided for a public comment period before the proposed criteria were submitted to Congress, "they clearly have not taken the comments seriously." He argued that DOE's estimate of its enrichment debt was far too high because it had assigned all of its investment and unrecovered costs to the commercial enrichment enterprise, and did not assign any costs to the defense program. Further, he maintained that if utilities are required to finance this debt through future prices paid to DOE for enrichment services, many utilities would contract elsewhere for enrichment, further jeopardizing DOE's cost recovery. Finally, he stated that the "policies embodied in (the new criteria) are directly detrimental to the (US uranium) mining industry because of the use of the federal stockpile and the low price that the Department will be placing on the stockpile uranium."

Ultimately, it is likely that one of the joint resolutions will be attached to a bill that is passed in both houses of Congress and signed by the President when Congress reconvenes in September. At present, the bill to increase the debt ceiling, with the Senate amendment attached, will probably pass within a relatively short time. At any rate, the rapid acceptance of both resolutions indicates that DOE's proposed criteria clearly do not have Congressional support. As it now stands, only a failure on the part of Congress to pass *some* virtually veto-proof legislation to accompany the disapproval amendment would allow the enactment of the proposed criteria. Currently, there are several bills pending that are almost certain to become law, any of which could serve as carriers of the disapproval amendment.

The strong Congressional opposition to the DOE maneuver could hurt DOE's chances in its appeal in the ongoing uranium producers' litigation before the Tenth Circuit in September. If Congress had ignored the submission of the proposed criteria, clearing the way for their acceptance, DOE could argue that its policies have the support of Congress. However, the US producers will almost certainly use the Congresssional opposition to argue that another powerful group is against DOE's current policies, a circumstance that is likely to have some influence on the appeal court's judgment as to whether DOE should be allowed to determine when enrichment limitations are necessary to support the US uranium production sector.

© NUEXCO 1986

FUEL CYCLE FACILITIES IN JAPAN

Introduction

Japan's fuel cycle companies and utilities are proceeding with their plans to build uranium enrichment, low-level waste storage, and reprocessing facilities at a common site in Aomori Prefecture. Located on the northern end of Japan's main island of Honshu (Figure 2), the site will encompass some 6.5 million square meters (2.6 square miles), including greenbelt areas around the facilities. Investment in the three facilities is likely to exceed US$4 billion, promising industrial growth for a less developed region in Japan. Moreover, the facilities represent another step in Japan's inclination toward self-sufficiency in the nuclear fuel cycle.

FEPC Proposal

Plant siting, particularly for waste storage and reprocessing facilities, has been an obstacle to the completion of the nuclear fuel cycle in Japan. Most spent fuel is currently stored on-site, though a portion is shipped to France and the United Kingdom for reprocessing. In mid-1984, the Federation of Electric Power Companies (FEPC), Japan's utility coordinating organization, announced a plan for the siting of the domestic enrichment, reprocessing, and storage facilities. The plan specified the Mutsu-Ogawara area of Aomori Prefecture as the location. The FEPC issued the proposal, subject to local and national government approvals, and the response in the prefectural area was favorable.

An alternate proposal released at the same time recommended locating the enrichment and waste storage facilities in the Mutsu-Ogawara area and the reprocessing facility at Higashidori, 30 kilometers to the north. Local and national governments had designated the Mutsu-Ogawara site for industrial development prior to the FEPC proposal; Higashidori was already designated as a future nuclear power plant site. Following the announcement, the prefectural governor met with national government officials to solicit cooperation in the implementation of the plan. Subsequent discussion by FEPC representatives with local officials and citizens' groups of Aomori Prefecture resulted in the selection of the single site for the entire complex, near the municipality of Rokkasho-Mura in the Mutsu-Ogawara industrial development area.

Later in 1984, the FEPC modified and formalized some of the details surrounding the complex, including facility capacities and scheduled operation dates. Table 3 summarizes some of the details of the planned complex.

Table 3

SPECIFICATIONS OF JAPAN'S COMMERCIAL FUEL CYCLE FACILITIES

	Uranium Enrichment Plant	Spent-Fuel Reprocessing Plant	Low-Level Waste Storage Plant
Location	Oishitai Rokkasho-Mura	Iyasakatai Rokkasho-Mura	Oishitai Rokkasho-Mura
(Prefecture)	Aomori	Aomori	Aomori
Operating Company	JNFI	JNFS	JNFI
Scale	Phase 1 - 600,000 SWU/year Phase 2 - 900,000 SWU/year 1.5 million SWU/year	800 tons/year plus 3,000 tons of spent-fuel storage	200,000 m³ (About one million 55-gal. drums)[1]
Area	About 3.0 square kilometers (including low-level waste storage area)	About 3.5 square kilometers	About 3.0 square kilometers (including enrichment facility)
Schedules			
Construction	Start in 1986	Start in 1986	Start in 1986
Operation	1991	1997	1991

[1]May be expanded to 600,000 cubic meters (about three million drums).

© NUEXCO 1986

NUEXCO

UPDATE

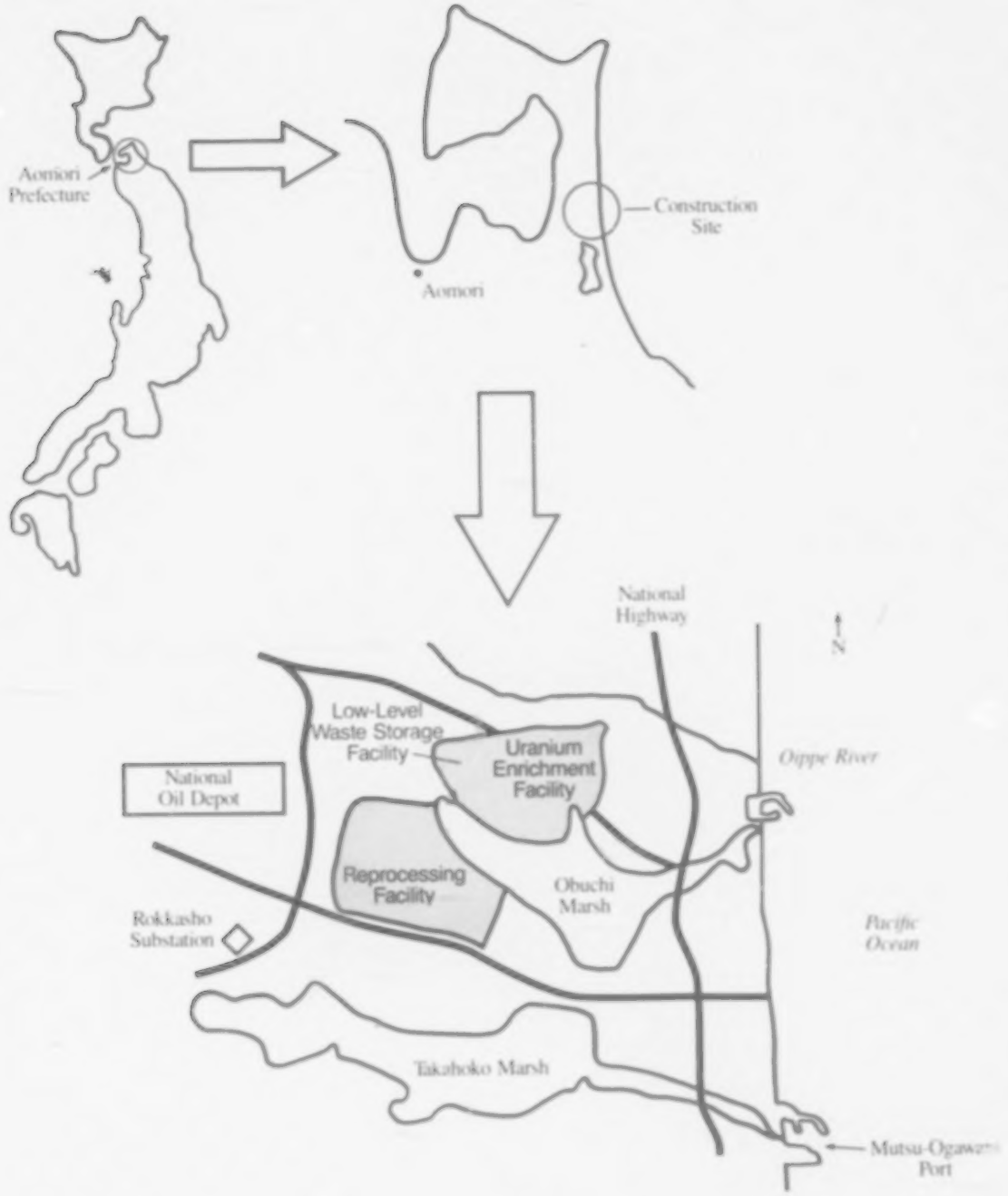


FIGURE 2. LAYOUT OF JAPAN'S FUEL CYCLE FACILITIES.

© NUEXCO 1986

Enrichment Plant

The Japanese utilities and other nuclear industry participants organized Japan Nuclear Fuel Industries (JNFI) in 1985 to own and operate a domestic enrichment plant with a capacity of 1.5 million SWU per year. Site environmental surveys and preliminary license preparations were initiated in early 1985, and the FEPC estimated that the plant will require an investment equivalent to approximately US$600 million. JNFI originally planned a progressive expansion of the enrichment facility, from an initial annual capacity of 150,000 SWU in 1991 to an annual capacity of 1.5 million SWU in 1997. The possibility of expansion to 3 million SWU per year in 2004 was also considered in the original plan. That figure would equal about one third of Japan's expected SWU requirements in 2004. Recently, however, JNFI and the utilities modified the plan, dividing it into two phases. Phase 1 will begin in 1988 with the construction of a 600,000 SWU per year plant. Although the exact schedule has not been determined, Phase 2 will add 900,000 SWU per year to the capacity, for a total of 1.5 million SWU per year capacity using centrifuge technology.

The facility's technology will be based on centrifuge technology developed by the Power Reactor and Nuclear Fuel Development Corporation (PNC). PNC is a quasi-government agency which developed the technology as a national project, primarily with government funding. Arrangements were completed to transfer the centrifuge technology from PNC to JNFI, but the commercial terms have not yet been announced. PNC began construction in November 1985 of a 200,000 SWU per year demonstration centrifuge enrichment facility on the western side of Honshu. The plant will act as a technology bridge between the PNC pilot plant (which confirmed PNC's technology) and the JNFI commercial-scale plant. Annual production of 100,000 SWU is scheduled for 1987 and full capacity of 200,000 SWU could be reached by 1988. In addition, PNC's demonstration plant output will serve the utilities' commercial power plants and is estimated to provide enrichment for two reloads annually.

Plant hardware for JNFI's commercial-scale facility will be supplied by Japan's three major nuclear manufacturers — Toshiba, Hitachi, and Mitsubishi Heavy Industries. These three companies participated as main subcontractors in PNC's previous enrichment development program. In 1985 their joint-venture manufacturing company, Uranium Enrichment Manufacturing Company (UEM), began construction of a new facility to produce centrifuge machines. Production is expected to begin in late 1986.

Although JFNI's initial plans called for a capacity of 3 million SWU per year at Rokkasho-Mura by 2004, several recent developments in the enrichment market influenced their facility planning. When the USDOE announced the cancellation of its gas centrifuge enrichment program (GCEP) in favor of existing diffusion technology as well as future laser technology, the Japanese utilities reevaluated their domestic programs and related economics, and considered the lower expected cost of enrichment using laser enrichment techniques. By the end of 1985, the utilities had decided to reduce the Rokkasho-Mura enrichment plant capacity to 1.5 million SWU per year using centrifuge technology, and to build a facility based on laser technology, possibly at a different location. The utilities, JNFI, and the Central Research Institute of the Electric Power Industry (CRIEPI) plan to conduct the joint development program. The group plans to spend approximately US$100 million over a five-year period, culminating in the operation of a laser enrichment facility with an annual capacity of 1,000 to 5,000 SWU. The start of the five-year period has not been scheduled, but the target date for commercialization of the project is the year 2000.

Reprocessing Plant

The Japanese utilities organized Japan Nuclear Fuel Services (JNFS) in 1980 to oversee the construction and operation of a commercial-scale reprocessing plant. The plant will consist of a reprocessing facility capable of processing 800 tons of spent fuel per year by 1995, and an adjacent 3,000-ton spent fuel storage facility, scheduled for operation in 1991. Most of Japan's spent fuel is stored by the utilities in pools at the nuclear plant sites, although some is being reprocessed via service contracts with European suppliers. The original reprocessing target of 1,000 tons per year in the early 1990s was modified several years ago. The estimated cost of the plant will be close to $3 billion.

The technology for the plant will be adopted from PNC's 210-ton per year demonstration plant at Tokai-Mura. PNC has operated the demonstration plant since 1977, based on European reprocessing technology, to serve as a basis for a domestic, commercial-scale facility. Although largely successful, the facility experienced numerous mechanical problems in its first several years of operation, processing less than 200 tons of spent fuel from domestic nuclear plants as of the end of 1983. Dissolver corrosion had caused the plant to be shut down in late 1983. In April 1985, PNC restarted the Tokai-Mura plant, reprocessing in excess of 70 tons of spent fuel from the Japanese utilities in the remainder of 1985. PNC planned to reprocess 140 tons of spent fuel during 1986.

The problems encountered by JNFS in finding a suitable location for a commercial-scale reprocessing plant were solved when the FEPC issued its proposal to locate all of the facilities at the Rokkasho-Mura site. As part of the joint siting, FEPC indicated JNFS would proceed with an initial spent-fuel storage facility capable of storing 3,000 tons of spent fuel by 1991. The

© NUEXCO 1986

facility would help to relieve some of the storage facilities at individual nuclear stations which have been accumulating increasing amounts of spent fuel. The 800-ton per year reprocessing plant is scheduled for completion in 1995, and provisions will allow for future expansion.

During 1985, JNFS proceeded with land-based environmental surveys and licensing activities for the reprocessing facility. It will introduce reprocessing technology which is based on that developed by the French company Fragema. JNFS also concluded basic negotiations whereby Mitsubishi Heavy Industries, with support from other nuclear manufacturers, would serve as the prime contractor for the new facilities. PNC will also have an advisory role in the reprocessing facility.

Low-Level Waste Storage

Part of the FEPC recommendation outlined a plan for the transport and storage of low-level waste generated by the nation's light-water reactors and other nuclear facilities. At present, each nuclear power plant has its own on-site storage for low-level wastes, such as contaminated equipment and clothing. By 1991, the national facility will have the capacity to store approximately one million 55-gallon drums. The original plan envisioned a possible expansion of the facility to allow for the storage of the equivalent of three million drums. The facility is expected to cost about $400 million.

Latest Developments

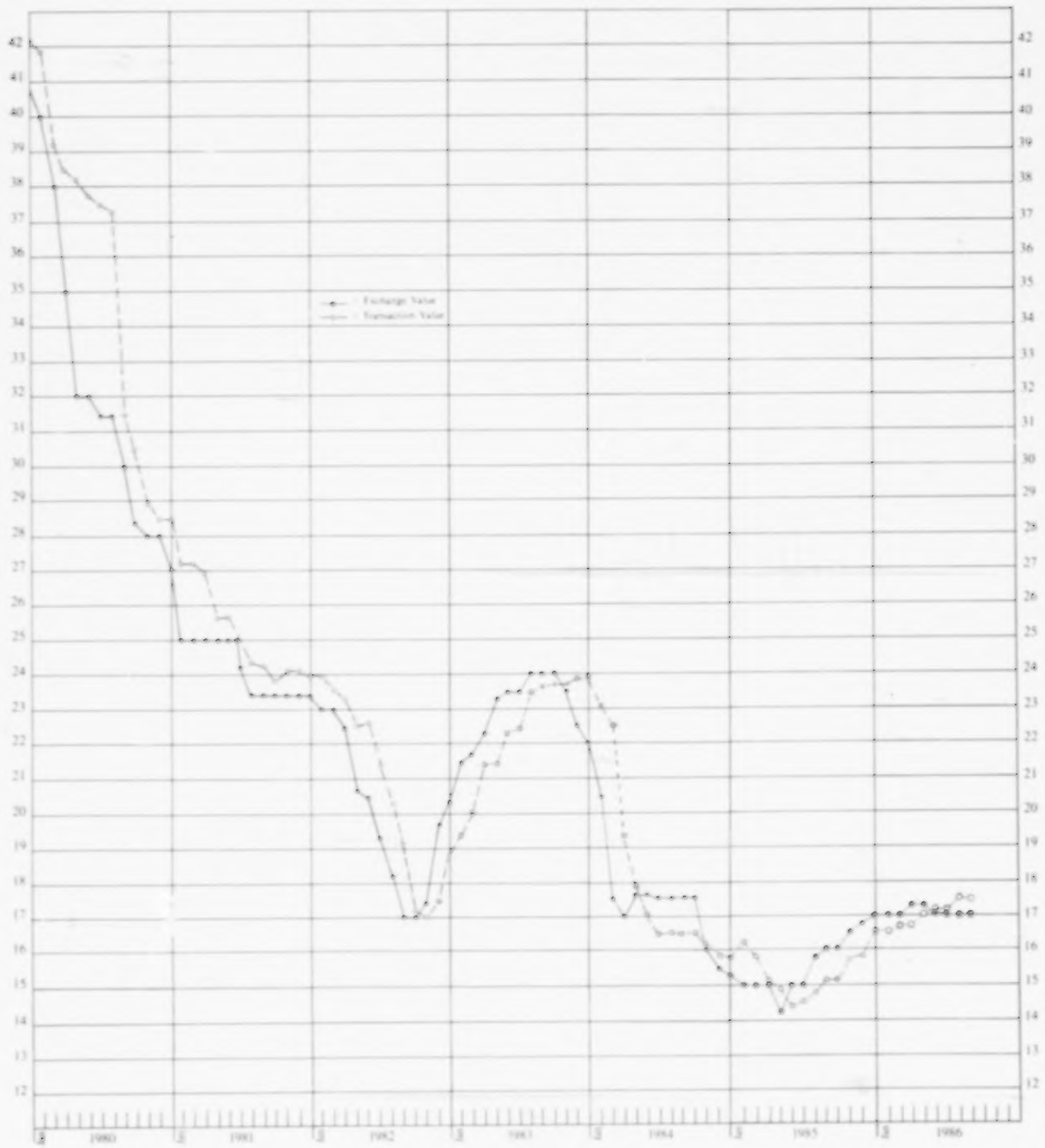
In preparation for sea area environmental surveys for the entire complex, JNFS and JNFI needed to obtain agreements from five local fishing associations. Although four agreements were secured during 1985, the fifth was not received until March 1986. Immediately thereafter, surveys, which will examine marine life and phenomena in the sea and marshes around the site, were initiated. At present, the companies intend to maintain their schedules for operation of the enrichment facility, low-level waste storage, and spent-fuel storage pool in 1991, despite some delays in site investigation work during 1985. JNFS and JNFI recently completed negotiations with the Ogawara Development Company for the purchase of the land for the sites. The two companies purchased almost 750 hectares (1,875 acres) at a cost of approximately 72.5 billion yen (about $450 million).

The Japanese consortium for reprocessing, JNFS and Mitsubishi Heavy Industries, rejected an offer from Societe Generale des Techniques Nouvelles (SGN), a subsidiary of the French fuel cycle company Cogema, to transfer reprocessing technology to Japan for $90 million and some future royalties. Thus, the reprocessing plant at Rokkasho-Mura may experience an additional two-year delay, in which case the plant could be in operation in 1997.

© NUEXCO 1986

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1980

Determined as of the last day of the month indicated



© NUEXCO 1986

NUEXCO

HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	16.00	16.50	16.75	17.00
1986	17.00	17.00	17.25	17.25	17.00	17.00	17.00	**17.00**				

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.50	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	15.10	15.75	15.80	16.55
1986	16.55	16.70	16.70	17.10	17.15	17.20	17.50	**17.45**				

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U in UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
1986	1.60	1.80	1.80	1.90	1.80	1.80	1.80	**1.90**				

© NUEXCO 1986

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry — All Groups[1] (1984 = 100)	Award Rates of Pay Indexes Australia — Adult Males In Mining Wage Earners, Weekly Rates[2] (1976 = 100)
1975 Avg.	150.4	132.6
1976 Avg.	168.4	160.9
1977 Avg.	192.0	179.0
1978 Avg.[3,4]	198.5	190.0
1979 Avg.	248.8	127.9
1980 Avg.	321.8	140.8
1981 Avg.	355.3	154.1
1982 Avg.[5]	368.6	174.9
1983 Avg.	401.6	181.8
FY84 Avg.[6]	95.3	—
FY85 Avg.[6]	100.0	—
Jan 1985	97.0	197.8
Feb 1985	98.6	197.8
Mar 1985	102.1	197.8
Apr 1985	104.4	202.8
May 1985	107.6	202.4
Jun 1985	108.7	202.4
Jul 1985	111.1	202.4
Aug 1985	110.5	202.4
Sep 1985	108.9	202.4
Oct 1985	108.7	202.4
Nov 1985	109.6	209.8
Dec 1985	110.2	209.9
Jan 1986	109.8	209.9
Feb 1986	108.9	209.9
Mar 1986	99.7	209.9
Apr 1986	94.5	209.9
May 1986	93.8P	209.9
Jun 1986	—	209.9

P = Preliminary R = Revised since last month

[1]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Ins." Catalogue No. 6411.0). The basis of this index was revised to 1984 = 100. The previous index was 1969 = 100.

[2]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0). Figures for the latest fourteen months shown are subject to revision.

[3]Monthly data for 1970-78 appear on pages 4.7 and 4.8 of Report 138.

[4]Annual averages prior to 1979 reflect index base no longer in use.

[5]Monthly data for 1979-82 appear on page 35 of Report 184.

[6]Annual averages are for financial year ending June 30.

© NUEXCO 1986

NUEXCO

GOVERNMENT STATISTICS

CANADA

	Industry Selling Price Index: All Commodities[1] (1981 = 100)	Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Non-ferrous Metal Industries[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1979 Avg.[6]	217.9	—	9.60	9.66	—	—	7.67
1980 Avg.	247.2	—	10.58	10.80	—	—	8.50
1981 Avg.	288.7	—	12.02	12.23	—	—	9.53
1982 Avg.[7]	288.8	—	13.74	13.92	—	—	10.63
1983 Avg.	298.8	—	—	14.30	—	—	11.17
1984 Avg.	310.9	17.88	—	15.07	12.28	10.49	11.76
Jan 1985	117.5	18.05	16.13	15.60	12.32	10.80	12.04
Feb 1985	117.7	18.78	16.41	15.68	12.52	11.05	12.06
Mar 1985	118.4	18.24	16.21	15.57	12.44	10.97	12.02
Apr 1985	118.3	18.63	16.44	15.80	12.81	11.23	12.04
May 1985	118.6	19.41	16.51	15.63	12.76	11.25	12.15
Jun 1985	118.6	18.49	16.20	15.49	12.89	11.14	12.14
Jul 1985	118.6	18.14	16.27	15.41	12.96	11.17	12.13
Aug 1985	118.4	17.07	16.03	15.30	12.97	11.31	12.19
Sep 1985	118.6	18.53	16.55	15.72	12.95	11.39	12.26
Oct 1985	119.0	18.74	16.51	15.70	13.14	11.53	12.33
Nov 1985	119.3	19.05	16.66	15.88	12.76	11.32	12.49
Dec 1985	120.0	19.07	16.57	16.01	12.51	11.09	12.59
Jan 1986	121.0	18.15	16.22	15.86	13.11	11.48	12.52
Feb 1986	129.9R	19.52	16.57	15.99	13.20	11.59	12.45
Mar 1986	120.3	19.04	16.65	15.93	13.11	11.59	12.54
Apr 1986	119.6R	19.38	16.68	15.95	13.07	11.64	12.54
May 1986	118.9R	19.54	16.68	15.78	13.16R	11.72	12.51R
Jun 1986	118.9	19.80P	16.63P	15.60P	13.04P	11.77P	12.42P

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011). Indexes for the most recent six months shown are subject to revision. This category was formerly known as "Manufacturing." Index prior to 1985, 1971 = 100.

[2]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002).

[3]Reports 175 through 185 list this series title incorrectly as "Metal Mining, Including Milling (SIC 050-099)."

[4]Beginning with the April 1983 figure, Primary Metal Industries, non-ferrous is split into SIC 296 and SIC 298.

[5]Chemical and Chemical Products prior to April 1983 was SIC 370-379. The new series is from a new survey which includes all companies and is based on a 1970 classification. The old survey only included companies of 20 employees or more.

[6]Monthly ISPI for 1977 and 1978 appear on page 4.10 of Report 138, and monthly wage-earner data for 1973-78 appear on page 4.11 of Report 138.

[7]Monthly data for 1979-1982 appear on page 37 of Report 184. On that page, the wage earner index entitled "Metal Mining, Including Milling (SIC 050-099)" should read "Total Mining (SIC 051-099)."

[8]Beginning with the March 1983 figure, Wage Earner Data are based on a census of all companies employing 200 or more wage earners, *plus* a random survey of companies employing fewer than 200 wage earners. Prior to March 1983 only companies employing 200 or more wage earners are included in the Wage Earner Data.

© NUEXCO 1986

REPUBLIC OF SOUTH AFRICA

		Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982 = 100)[2]	Consumer Price Index[3] (1980 = 100)[4]	Producer Price Index All Groups[5] (1980 = 100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1975	Avg.	16.71	—	157.2	100.0	639,473	1,003,617
1976	Avg.	19.30	—	174.7	115.1	671,240	1,212,983
1977	Avg.	23.87	—	194.4	130.0	712,006	1,420,670
1978	Avg.	27.14	—	137.2	142.7	664,571	1,537,169
1979	Avg.[7]	30.18	—	155.3	164.5	692,209	1,830,632
1980	Avg.[8]	35.53	—	176.7	192.1	714,379	2,279,615
1981	Avg.	41.89	—	206.5	218.3	728,506	2,820,505
1982	Avg.[9]	47.25	104.2	233.5	248.7	707,552	3,246,071
1983	Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
1984	Avg.	58.95	130.3	292.8	297.9	712,080	4,196,764
Jan	1985	—	—	177.1	166.6	711,366	376,777
Feb	1985	—	—	182.8	171.3	727,932	361,823
Mar	1985	64.48	142.4	183.6	173.0	708,809	371,380
Apr	1985	—	—	187.4	174.0	724,187	369,005
May	1985	—	—	189.5	177.7	708,085	373,478
Jun	1985	67.42	148.9	191.9	179.2	724,587	395,543
Jul	1985	—	—	193.6	180.7	738,228	419,106
Aug	1985	—	—	195.6	183.2	734,121	416,777
Sep	1985	70.47	155.3	197.8	184.8	732,836	419,883
Oct	1985	—	—	200.8	188.1	720,071	401,448
Nov	1985	—	—	203.4	196.0	750,049	432,996
Dec	1985	72.43	160.1	207.4	199.4	741,372	425,261
Jan	1986	—	—	213.8	203.6	744,070	449,513
Feb	1986	—	—	215.8	206.9	754,458	438,562
Mar	1986	75.76	167.8	218.3	206.9	759,897R	445,387R
Apr	1986	—	—	222.2	208.9	756,388	437,563
May	1986	—	—	222.6	212.5	754,788	425,544
Jun	1986	77.65	172.0	224.4	213.3	—	—
Jul	1986	—	—	228.8	—	—	—

[1]Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.

[2]Page 16 of Report 178 contains description and calculation of index, and page 24 of Report 178 lists figures for 1982.

[3]Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."

[4]The basis for calculation prior to January 1985, 1975 = 100. For annual averages prior to 1978, April 1970 = 100.

[5]Previously known as the Wholesale Price Index, now the Producer Price Index. The computation remains the same. The basis for calculation prior to January 1985, 1975 = 100.

[6]Bulletin of Statistics, Department of Statistics, Pretoria.

[7]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Report 140.

[8]Monthly data for Codes 35 and 40, 1977-1980, appear on page 28 of Report 157.

[9]Monthly data for 1979-82 appear on page 39 of Report 184.

© NUEXCO 1986

NUEXCO

GOVERNMENT STATISTICS

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3,4]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[5]			
	Industrial Commodities (1967 = 100)	All Commodities (1967 = 100)	(1967 = 100)	(1982 = 100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1980 Avg.[6]	274.8	268.8	246.8	178.64	10.26	10.63	8.30	6.94
1981 Avg.	304.1	293.4	272.4	195.51	11.55	11.98	9.12	7.62
1982 Avg.[7]	312.3	299.3	289.1	207.15	12.33	12.94	9.96	8.21
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
1984 Avg.	322.6	310.3	311.1	108.1	13.05	13.43	11.08	9.04
Jan 1985	322.9	309.5	316.1	—	13.29	13.70	11.39	9.33
Feb 1985	322.5	309.2	317.4	—	13.30	13.73	11.39	9.33
Mar 1985	322.6	308.7	318.8	110.4	13.29	13.95	11.37	9.39
Apr 1985	323.8	309.3	320.1	—	13.43	13.63	11.47	9.40
May 1985	325.3	309.8	321.3	—	13.24	13.60	11.44	9.39
Jun 1985	324.8	309.2	322.3	111.3	13.23	13.68	11.51	9.46
Jul 1985	324.4	309.0	322.8	—	13.45	13.83	11.59	9.47
Aug 1985	323.7	307.3	323.5	—	13.55	13.71	11.60	9.50
Sep 1985	322.3	305.5	324.5	112.1	13.44	13.68	11.65	9.54
Oct 1985	324.2	307.9	325.5	—	13.49	13.66	11.70	9.55
Nov 1985	324.7	309.5	326.6	—	13.49	13.97	11.80	9.61
Dec 1985	325.1	310.2	327.4	113.0	13.43	13.81	11.85	9.68
Jan 1986	323.8R	308.9	328.4	—	13.40	13.69	11.86	9.60
Feb 1986	318.9	304.4	327.5	—	13.44	13.82	11.81	9.60
Mar 1986	314.0	300.3	326.0	113.5	13.38	13.93	11.78	9.62
Apr 1986	311.3	297.9	325.3	—	13.54	13.87	11.82	9.62
May 1986	311.7	299.2	326.3	—	13.46R	13.79R	11.89R	9.64
Jun 1986	311.6	298.9	327.9	114.2R	13.52P	13.50P	11.95R	9.60R
Jul 1986	308.5	297.7	328.0	—	—	—	12.08P	9.61P

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

[2]US Bureau of Labor Statistics, Washington, D.C.: Consumer Price Index for All Urban Consumers, US City Average, All Items.

[3]US Department of Commerce, Washington, D.C.: Bureau of Economic Analysis, National Income and Wealth Division: "Survey of Current Business." The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

[4]The basis for calculation of this index was revised to 1982 = 100. 1984 and 1985 figures have been adjusted to that basis. The basis for calculation prior to 1984, 1972 = 100.

[5]US Bureau of Labor Statistics, Washington, D.C.: "Employment and Earnings." All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

[6]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Report 154.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

[7]Monthly data 1979-1982 for all listed indices appear on page 41 of Report 184.

© NUEXCO 1986

NUEXCO

REPRESENTATIVES AND CONSULTANTS

JAPAN

Kazy Yokota
Japan Tech Services
Ohkura Building (3F)
1-4-10 Shiba Daimon
Minato-ku, Tokyo, Japan
Telephone: (81-3) 431-6031, 6025
Telecopy: (81-3) 434-6674
Telex: 242-5060 (JATECH J)

SOUTH AFRICA

Chris I. Von Christierson
Southern Prospecting (Pty) Limited
P.O. Box 61409
Marshalltown 2107
Republic of South Africa
Street Address:
10th Floor
Eagle Star House
70 Fox Street
Johannesburg 2001
Telephone: (27-11) 838-1868
(27-11) 834-4211
Telecopy: (27-11) 834-3148
Telex: 4-89878 SA

TAIWAN

Edward Bee
Bee & Liang Company, Ltd.
14 FL Universal Business Center
NO. 663, Tun Hwa South Road
P.O. Box 1396
Taipei, Taiwan R.O.C.
Telephone: (886-2) 704-9630
TWX: 785-11570 (BEELIANG)

UNITED STATES

Harold C. Lindberg
83-A Hardee Lane
Whispering Pines, N.C. 28327
Telephone: (919) 949-3622

SPECIAL CONSULTANTS

George J. Stathakis
International Investment Banking

James C. C. Stewart
U.K. Nuclear Industry

W. Bryan Webster
International Business Development

J. Robert Wolcott
International Business Development